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CENTRAL INTELLIGENCE AGENCY

# INFORMATION REPORT

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COUNTRY Yugoslavia

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SUBJECT Prevention of Ice Formation on Passenger Transport Planes.

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25X1X SOURCE [redacted]

1. The forward edges of the wings and tail surfaces are protected from freezing by means of a thermal system. Heating of these surfaces is accomplished by means of warm air which is heated by the exhaust gases or by special heaters. The system employing exhaust gases is less heavy, but complications occur with this type of heating because of lead compounds contained in the vapors. For this reason the system with special heaters has been adopted, in spite of the fact that it is heavier.

2. This second system operates on the principle that air passes into a heater which burns gasoline, the warm air then being conducted through pipes along the forward edges of the wings and then right into the forward edge which has a double wall. The outer wall constitutes the forward edge of the wing, whereas the inside wall consists of a metal plate covering the surface to be heated. The temperature of the warm air is regulated within a range varying between 150 and 170 degrees centigrade. The air is heated in such a way that the system can successfully operate at heights of 7,000 meters and in temperatures below 20 degrees centigrade. The amount of heat produced causes the water which gathers on the forward edges of the wings to evaporate, under conditions where the atmosphere contains 0.5 gr. $m^3$ of condensed water, with drops the size of 10 to 20 microns, at an air speed of 380 to 400 kilometers per hour. Under these conditions the temperature of the forward edge of the wing should be 30 to 40 degrees above the outside temperature. The DC-3 planes of the Yugoslav Air Transport JAT have a heating system which consists of three heaters. One of these is in each wing and serves to heat the forward edges of the wing. Their capacity amounts to approximately 60,000 Cal. Kg/sec. The third heater, with a capacity of 100,000 Cal. Kg/sec is located in the tail and serves to heat tail surfaces.

3. The amount of heat radiated is not regulated. A valve has been installed which is turned on when there is danger of freezing, and the entire heating system is then put into operation; it is turned off when danger of freezing has abated. The conduit of air is, however, regulated by a special apparatus which regulates the composition of the air mixture depending upon the height and passage of air. As a protective measure there is a bimetallic plug which cuts off entry of the fuel, whereupon the temperature in the heater rises above a certain determined limit as a result of insufficient quantities of air. Another plug, operating as a result of the aircraft speed and independently of the aerodynamic pressure,



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acts as an additional safety measure. This plug makes heating of the air possible only when the speed of the airplane reaches 150 km. per hour and when sufficient amounts of air run into the heaters.

4. The air conduit is located on the forward edge of the wing and is exposed to the stream of air coming from the propeller. It divides the air into two parts: one part serving to heat the gasoline, and the other part to be heated. Exhaust gases from the heater are conducted by means of a short conduit to the upper surface of the wing where a lower pressure directly sucks these gases into the atmosphere.

5. Warm air is conducted from the burner to the forward edge of the wings through pipes of a light material well-adapted to vibrations and changing flying conditions. In addition, each heater is supplied with a compressor which serves to set the system into operation when the plane is on the ground as well as when tests have to be made with fire-fighting equipment. This compressor is put into operation either by an inertia (sic) plug which functions if there is an accident, or else by a plug located in the pilot's cabin, which is put into operation when the red danger light goes on.

6. Before the thermal system was installed on the JAT passenger planes the mechanical system of de-icing was used. In this system, the forward edge of the wing is covered with a specially constructed rubber surface which contains chambers running along the length of the forward edge of the wing. Condensed air, which comes either from the exhaust side of the vacuum pump or from a separate pump, is pumped alternately into the chambers via a rotating separation valve. The chambers then expand and deform the forward edge of the wing. This deformation breaks up the ice which has gathered on the edges of the wings, and the air current disposes of it. This system is supplied with a centrifugal oil separator which must be separated from the air because the oil has a very destructive effect upon the rubber.

7. In order to defreeze the propeller, a rheostat is used to regulate the speed of the pumps and also the amount of liquid which is conducted to the leading edge of the propeller. The leading edge of the propeller is covered with a rubber surface pierced by gas channels which conduct the liquid throughout the entire length of the leading edges. The liquid for defreezing consists of a solution of 15 percent glycerine and 85 percent pure ethyl alcohol. In some planes a different method using electric heating prevents the propeller from freezing. In the latter case, the heat conductor is an electric wire. All these wires are connected to, and are heated by, the electrical system of the plane (12 or 14 volts). This system has been installed only on airplanes used for special missions, such as transportation of important persons. There are five such planes in Yugoslavia.

8. In order to prevent freezing of the carburetor, all motors are equipped with an apparatus to heat the air before it reaches the carburetor. As a special precaution, alcohol is sprayed in with the fuel.

9. In order to keep the windows from freezing, it is planned to devise a windshield wiper which will be operated either by electricity or a water system which will spray alcohol on the window. So far only Tito's personal plane is equipped with a system that heats windows by means of warm air channeled from the heating system of the cabin.